A DESCRIPTION and EXPLANATION

New MAP of the WORLD,

AND

Ten Aſtronomical DIAGRAMS; exhibiting, by INSPECTION, the FIRST PRINCIPLES of GEOGRAPHY and ASTRONOMY.

A Perſon ever ſo little acquainted with the nature of *Maps* will readily ſee the Difference, between this on the GLOBULAR PROJECTION, and that which is in common Uſe; and be convinced of the ſuperior Advantages of the former, and the Preference due to it on that Account. A MAP of the WORLD has been always eſteemed one of the fineſt Effects of Mathematic Science; and to render it compleatly uſeful, for conveying, as it were, by Inſpection, the *Firſt* PRINCIPLES of GEOGRAPHY, and practical ASTRONOMY, I have addreſſed this Map to the Public under the following numerous, but neceſſary Particulars.

1. It is made on the *Globular* (inſtead of the *Stereographic*) PROJECTION, by which Means the *Meridians* are all *equidiſtant*, as on the GLOBE itſelf; and therefore the Form, Site, compara-

tive Magnitude, &c. of the ſeveral Countries, are much leſs diſtorted and erroneous than in the common ſort of Maps; and are, indeed, as little ſo as the Nature of a *Projection*, or *Map*, will admit of.

2. All Parts of the *Terraqueous* GLOBE are very carefully delineated according to the lateſt and moſt accurate Diſcoveries that have been made to the preſent Time, and engraved by Mr. EMANUEL BOWEN, GEOGRAPHER to his late MAJESTY.

3. In this Map, the *Firſt* MERIDIAN paſſes thro' LONDON; and thereby facilitates the Ideas of all that pertains to the doctrine of *Longigitude*, whether in *Motion* or *Time*; for

4. The MERIDIANS are drawn thro' every 15th Degree of Longitude to the EAST, and WEST; and by this means they become HOUR-CIRCLES, and give the Time in the various parts of the World when it is NOON at LONDON; and *vice verſa*.

5. Thus in the *Eaſtern* HEMISPHERE the Numbers I, II, III, IV, V, VI, &c. in the Equator, ſhew the Time in the *Afternoon* when it is Noon at LONDON. But the ſame Numbers in the Parallel of 50° South, ſhew the Hour at LONDON when it is Noon to the Countries under the reſpective Meridians. For Example, When it is XII at LONDON, it is V in the Afternoon on the Coaſt of *Malabar* in the *Indies*; when it is Noon on that Coaſt, it is VII. in the Morning with us, as is ſeen in the ſaid Parallel of 50°.

6. Accordingly, in the *Weſtern Planiſphere*, the ſaid Numbers in the Equator ſhew the Time in

in the *Afternoon* at LONDON, when it is Noon at the Countries lying under any particular Meridian; for Example, when Noon at *Jamaica*, it is V. Afternoon with us; and in the Parallel of 50°, it appears, that when it is XII. at LONDON it is VII. in the Morning at *Jamaica*.

7. The LONGITUDE is here reckoned upon the Equator in Degrees, viz. 10, 20, 30, &c. to 180 in each Planiſphere from the firſt Meridian through LONDON; ſo that it is inſtantly ſeen what the Longitude of any Place is, and whether *Eaſt* or *Weſt* from LONDON.

8. The LATITUDE of Places is ſhewn by the Parallels thro' every 10 Degrees, and numbered in the *firſt* Meridian 10, 20, 30, &c. to 90 at the *North* or *South Pole*; as in all other Maps. The intermediate Degrees both of Longitude and Latitude are eaſily judged of; thus it is readily ſeen that the Longitude of *Port Royal* in *Jamaica*, is about 77°. Weſt, and the Latitude thereof a little more than 18°. North.

9. The HORIZON of LONDON is drawn in each Hemiſphere and divided into its proper Degrees, viz. 10, 20, 30, &c. to 90, from the *Eaſt* and *Weſt Points* to the *North* and *South*; by theſe the degrees of *Amplitude* and *Azimuth* are eſtimated. Alſo the Points of the Compaſs are there ſhewn for judging of the reſpective Situation, or *Bearing of Places from London*; &c. for which end the *Vertical Circles* are drawn thro' the 8 Cardinal Points.

10. The LENGTH of the DAY and NIGHT is ſhewn by the length of the parallels (between the Tropics) above or below the Horizon through

out the year; and thereby a natural Idea or Notion of the *Seaſons* of the Year, is at all times acquired.

11. The CALENDER of MONTHS and DAYS is placed by the ECLIPTIC, by which the Sun's Place is found for any given Time, near enough for common Uſe.

12. The SUN'S PLACE being known, his Declination is alſo known by the Parallel which paſſes thro' it: for the Parallels of Latitude are equally the Parallels of the Sun's Declination from the Equinoctial Line.

13. The TIME of the SUN'S RISING or SETTING is ſhewn by the Hour-Circle meeting the Parallel of his Declination in the Horizon. Thus when the Sun has 12°. Declination North, the Parallel of 12°. is cut by the Hour Circle of V. in the *Eaſtern Horizon*, which ſhews the Time of *Sun-Riſing*; and by the Hour Circle of VII. in the *Weſtern Horizon*, which is the Time of *Sun-Set*.

14. The Time of *Twilight* is ſhewn through out the Year by the circle of *Crepuſculum*, drawn 18°. below the Horizon in both Hemiſpheres, and which is denoted by ſmall Dotts. The Parts of the Parallel of Declination within this dotted Space ſhew the Length of Twilight, Morning and Evening, by the Hour Circle meeting the ſaid Parallel in the Crepuſcular Circle. Thus when the Sun has about 12°. South Declination, the Twilight begins at V. in the Morning and ends at VII. or *Sun-Riſing*; and *vice verſa* in the Evening.

15. Whence it appears that after the Sun has about 20°. North Declination, there can be no

dark

dark Night, which will be the Caſe from May 22d to July 15th, as appears by the Calendar on the Ecliptic.

Theſe are the principal Uſes of the Projection or Map of the World itſelf; which thus conſtructed may be properly ſaid *to be rectified for the* CITY *of* LONDON, and the ISLAND of GREAT BRITAIN in general.

The USES of the *Aſtronomical* DIAGRAMS.

DIAGRAM I. Exhibits an Idea of the SOLAR SYSTEM, or the *True* SYSTEM of the WORLD, conſiſting of the SUN in the Center, and the ſix *Primary* PLANETS in their true *proportional Diſtances* from him; theſe with the Times in which they ſeverally revolve about the Sun, are found by Obſervations, as ſpecified in the annexed Table.

PLANETS.	Diſtances.	Periodical Times.
		D. H.
MERCURY	38710	87 : 23 : 14′ : 34″
VENUS	72333	224 : 16 : 41 : 30
The EARTH	100000	365 : 5 : 49 : 25
MARS	152369	686 : 22 : 18 : 19
JUPITER	520096	4330 : 8 : 35 : 0
SATURN	954006	10750 : 13 : 14 : 42

Beſides theſe, the ORBIT of the COMET (foretold by Dr. HALLEY) which appeared in 1758 is here repreſented in Part: its Revolution is made

made $75\frac{1}{2}$ Years, at a Mean. The Number of the Comets is not yet known, tho' near 50 have been obſerved, all different from each other. So little do we know of much the greateſt Part of *one Mundane Syſtem* only, out of an infinite Number!

DIAGRAM II. Preſents to the View the JOVIAN SYSTEM of *Secondary* PLANETS, called *Satellites*, or *Moons*; thoſe which belong to JUPITER are *Four*, which are here repreſented in their ſeveral Orbits at their due proportional Diſtances from the Primary; in Meaſures of his Diameter, as taken with a Micrometer. Theſe Moons are eaſily ſeen by a Teleſcope, which will magnify about 30 Times; they all move nearly in the ſame Plane, which, as it paſſes thro' the Eye, muſt ſhew thoſe ſmall Planets always in the Diameter of their Orbits, and not in their real Places as 1, 2, 3, 4. So that their Appearance is nearly in a Right Line as here ſhewn at *a*, *b*, *c*, *d*. The following Table ſhews their Diſtances in Semidiameters of Jupiter from his Center, and the Times of their Revolution about him.

SATELLITES.	Diſtances.	Periods
		D. H.
Firſt	5,67 ſemid.	1 : 18 : 27′ : 34″
Second	9,00	3 : 13 : 13 : 42
Third	14,38	7 : 3 : 42 : 36
Fourth	25,3	16 : 16 : 32 : 9

DIAGRAM

DIAGRAM III. Is a View of the SATURNIAN SYSTEM of 5 SATELLITES or MOONS which circulate about that remote Planet, at the Diſtances (eſtimated in Semidiameters of his Ring) and in the Times as they are expreſſed in the Table here annexed. His Moons are deſigned to reflect Light undoubtedly, but what end is anſwered by that ſtupendous RING which ſurrouuds his Body, is not yet known. Teleſcopes magnifying 30 Times ſhew the wondrous Phaſes of this Ring; but they muſt magnify 100 Times to ſhew 2 or 3 of his Moons; and about 200 Times, to ſhew all the Five. They all move in nearly the ſame Plane, which makes an Angle with Ecliptic of about 31 Degrees; their motions, therefore, will appear to us as if performed in *Ellipſes*, as repreſented in Diagram VI. The periodical Times and Diſtances of theſe 5 Satellites are confirmed by Obſervations (agreeing with the *Theory*) as follow.

SATELLITES.	Diſtances.	Periodical Times.
		D. H.
Firſt	2,097	1 : 21 : 18′ : 27″
Second	2,686	2 : 17 : 41 : 22
Third	3,752	4 : 12 : 25 : 12
Fourth	8,698	15 : 22 : 41 : 12
Fifth	25,348	79 : 7 : 47 : 0

DIAGRAM IV. Is a genereal Repreſentation of the THEORY of the EARTH's *Annual* MOTION about the SUN, for explaining the *Rationale* of the SEASONS, and the variable LENGTH of DAY and

and NIGHT through out the Year. To this End the Earth and its Circles are projected upon the Plane of the *Ecliptic*, in four Position; viz. in *Libra* ♎, *Capricorn* ♑, *Aries* ♈, and *Cancer* ♋, in the Middle of the SPRING, SUMMER, AUTUM, and WINTER Seaſon: P is the *North Pole*, and LOND the *Parallel* of LONDON; then it is evident, that in the Firſt Poſition at ♎, the Circle of Illumination is the *Solſtitial Colour* ♋ P ♑, which, as it paſſes thro' the Pole P, biſects the Parallel LOND (and all others;) and therefore the Diurnal Half LON in the enlightened Hemiſphere, being equal to LDN in the Dark one, ſhews the *Day is now equal to the Night*, not only at London, but over the whole Earth. This makes the *Vernal* EQUINOX.

In the ſecond POSITION of the Earth at ♑, by reaſon the Axis is always inclined to the Plane of the Ecliptic 23° 30′, and conſtantly parallel to itſelf, the Pole P will be turned to the Sun the moſt it can be, viz. it will be 23° 30′ in the illuminated Hemiſphere; and ſo the Circle of Illumination will divide the Parallels *very unequally*; whence the *diurnal Part* LON is now much larger than the *Nocturnal Part* LDN, which repreſent the longeſt DAY and ſhorteſt NIGHT at London, in the SUMMER SEASON.

In the *Third* POSITION, at ♈, the Circle of Illumination paſſes again thro' the Poles P, and therefore makes the Day LON equal to the Night LDN (as before in the Firſt Poſition) which is now the *Autumnal* EQUINOX.

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In the *Fourth* POSITION at *Cancer* ♋, the North Pole P juſt as much declines from the Sun, as before it inclined towards it; and is therefore now 23° 30′ in the *dark Hemiſphere*; conſequently the *diurnal* Part LON is now much leſs than the *Nocturnal* Part LDN; and therefore the Day is proportionably ſhorter than the Night at LONDON, and all *North Latitudes* in the Middle of WINTER.

Now tho' it be demonſtrable from the Sun's leſs apparent Diameter in the Summer, that he is then at a greater Diſtance from us, yet it muſt be *hotter* in that Seaſon than at any other, for the following Reaſons, viz. (1.) The Sun-Beams fall on us then *moſt directly*, and ſtrike with greater Force. (2.) A *greater Quantity* of Rays will then fall on a given Space, as our *Iſland*, &c. and therefore heat it more. (3.) The Rays then paſs thro' leſs of the *Atmoſphere*. (4.) The Days are then longeſt, and the Nights ſhorteſt. All which co-operate to make this the *hotteſt* and moſt *lightſome* SEASON of the Year; and becauſe they are all reverſed in the oppoſite, or 4th Poſition, it muſt be then WINTER. In the firſt and third Poſition, theſe Cauſes are in a mean Degree, and produce the milder SEASONS of SPRING and AUTUMN.

DIAGRAM V. Conveys the Ideas of the *Heliocentric* and *Geocentric* PLACES of the PLANETS; their *direct* and *retrogade* MOTIONS, and STATIONS; their CONJUNCTIONS, and OPPOSITIONS; ELONGATION, PARALLAXES, &c.

The *Heliocentric* PLACE of a Planet is that Sign and Degree of the Ecliptic in which it is ſeen from the Sun S; thus the Planet VENUS at B is viewed from the Sun at I. in about 22° of

♏; and Mars at D is ſeen in about the 8th Degree of *Aries* ♈. Suppoſe now the Earth is in its Orbit at A, and the Ecliptic placed about it in a Poſition ſimilar to that about the Sun; then the viſual Ray AB will ſhew *Venus* at B in nearly the 12th Degree of *Libra* ♎; and Mars at D in 20° of ♉; and theſe are the *Geocentric* PLACES of the ſaid Planets at G and E.

If the Earth be at C, and the Ray C*a* touches the Orbit of Mercury in Q, then ☿ at Q would appear among the Stars at (*a*), if the Earth were at Reſt in C; then while the Planet moves from Q by N to K, it will appear to move among the Stars from (*a*) to (*b*). This Motion is from EAST to WEST, and is therefore the *Direct* MOTION. But while ☿ moves from K by M to Q, the viſive Ray C*b* will return back, and ſhew the Planet *Retrogade* from *b* to *a*. And ſince the Rays touch the Planets Orbit in K and Q, the Planet will not ſeem to move, but be *Stationary*, for ſome Time in the Heavens at *a* and *b*. And the ſame Phænomena will happen (in all the Planets) tho' the Earth be in Motion.

It is further evident that when the *Inferior Planets* are at L and M, they are then in the *lower* CONJUNCTION; but when they are at N and O, they are ſeen from C in their *higher* CONJUNCTION with the Sun. A Superior Planet can have but *one* CONJUNCTION, as Mars at D; but in the Poſition P it will appear at the Earth at C in OPPOSITION to the Sun S. In all theſe Caſes, the Planets are in a Right Line joining the Earth and Sun.

The Inferior Planets can have no OPPOSITION to the Sun; and their *greateſt* ELONGATION, or Diſtance

Diſtance from him, is denoted by the Angle SCQ or SCK in *Mercury*, or SCB in *Venus*; the former about $22^{\circ}\frac{1}{2}$ and the latter about 47°, agreeable to Obſervation.

The Difference between the *true Place* of a Planet at B or D as ſeen from the Sun S, and the *apparent Place* as ſeen from the Earth A, is called the PARALLAX of the PLANET; and is meaſured by the Angle ABS or ADS, which is therefore called the *Parallatic Angle*, or *Parallax* of the *Annual Orbit*, as being occaſioned by its Semidiameter AS.

DIAGRAM VI. Is taken from the learned HUGENIUS, and is a Natural Repreſentation of the *Apparent Elliptic* MOTIONS of SATURN's 5 Satellites, as they would appear to the Eye thro' a Teleſcope. See DIAG. III.

DIAGRAM VII. Exhibits the THEORY of our own SATTELITE or MOON, with Reſpect to her PHASES, ECLIPSES, both *Solar* and *Lunar*, &c. In order to underſtand which, let S be the SUN, E the EARTH, and N, Q, F, the MOON in ſeveral Poſitions of her Orbit about the Earth. Then ſince both the Earth and Moon are *Opake Bodies*, they will caſt a *dark* SHADOW behind them; and becauſe they are Globular, that Half of their Bodies next the Sun will be enlightened, and the other dark; hence as the Moon revolves about the Earth, ſhe muſt appear *wholly dark* or *New* at the CONJUNCTION N; *dichotomized* or *half Light*, and *half dark* at the QUARTERS Q; and wholly enlightened, or *full* at the OPPOSITION F; and in the other Parts, ſhe is more or leſs enligtened as ſhewn in the Scheme.

It is found by Obſervation, that the Moon always ſhews to us the *ſame Side or Face*; which proves that her *diurnal* MOTION about her AXIS is performed in the ſame Time as her REVOLUTION about the Earth, viz. in 27D. 7H. 43′; and conſequently the LENGTH of *Lunar* DAYS and NIGHTS are about $13\frac{1}{2}$ of ours or near a *Fortnight* each.

From the Diagram it further appears, that if the Orbit of the Moon were in the Plane of the Ecliptic or Orbit of the Earth, then every NEW MOON at N would produce a *total* and *central* ECLIPSE of the SUN, by the dark Shadow N *c* in that Part of the Earth which lies under the Ecliptic; becauſe the apparent Surface of the Moon is always nearly equal to that of the Sun.

But there is a conſiderable Diſtance from *(c)* all around to *(a)* and *(b)* where the Sun would be eclipſed only in Part, ſince it is evident a Spectator at *(a)* and *(b)* would ſee the whole Diſk of the Sun; and this Space for a *Partial* ECLIPSE, viz. from *(a)* to *(b)* is almoſt 5000 Miles; the dotted Space *a* N *b* is uſually called, the *Penumbra* or *penumbral Shadow* of the Moon.

Again, the FULL MOON F would always be involved in the Shadow of the Earth (*d e f g*), and centrally *obſcured* or *eclipſed* for a conſiderable Time, as the Diameter of the ſhadow (*f g*) is about three Times as large as that of the Moon. But as theſe *Solar* and *Lunar* ECLIPSES do not happen but at two particular Times of the Year, at the diſtance of ſix Months, therefore it is plain the *Orbit of the Moon is inclined to the Plane of the Ecliptic*; and that is found to be in an Angle of 5° 18′. Therefore

DIAGRAM

DIAGRAM VIII. Repreſents the Varieties of a *Lunar* ECLIPSE; where the ſtrait Line AE is a ſmall Part of the *Ecliptic*; FH Part of the Moon's Orbit, interſecting the Ecliptic in the Node ☊, and making an Angle H ☊ E of 5°. 18′. In the Ecliptic, the *Section* of the *Earth's Shadow* is repreſented at ☊, B, C; and then it is evident (1.) That if the FULL-MOON ſhould happen in the NODE ☊, it muſt be *centrally and totally Eclipſed*. (2.) The Moon may have ſuch Latitude, as at I, that it may be *totally*, tho' not *centrally eclipſed*. (3.) It may be *partially eclipſed*, as between I and N. (4.) In the Poſition of the *Full Moon* at N, her Limb will *juſt touch the Shadow*; and therefore when ſhe is farther from the Node ☊, ſhe can ſuffer *no Eclipſe* at all. (5.) Hence the LIMIT of a *Lunar* ECLIPSE is, on each Side the Node, ☊ N, which is about 12 Degrees.

DIAGRAM. IX. Exhibits the Circumſtances of a *Solar* ECLIPSE. Here AE, FH are ſmall Portions of the *Ecliptic* and *Lunar Orbit*, and ☊ the *Node*, as before. The *enlightened* SURFACE or DISK of the EARTH is denoted by ÆPQS and the *Dark* and *Penumbral* SHADOWS of the NEW-MOON ſhewn at ☊, R, N. Then (1.) it is plain, that if the *New-Moon* happen in the *Node* ☊, there will be both a *total and central* ECLIPE of the SUN. (2.) The MOON's Latitude BR may be ſuch as will produce a *total* tho' not *central* ECLIPSE. (3.) If the *dark Shadow* does not fall upon the Earth's Diſk, the *Penumbral Shadow* may, and that will produce a *Partial* ECLIPSE. (4.) In the *Poſition* of the Earth at C the neareſt Diſtance of the centers of the

the Earth and Shadows is such that the Penumbral Shadow does but *just touch the Earth*; and therefore (5.) The Distance of the Earth from the Node ☊ C is the LIMIT (on each side) of *Solar* ECLIPSES, which is about $16\frac{1}{4}$ Degrees.

DIAGRAM X. Is a View of the two late memorable TRANSITS of VENUS, and one of MERCURY, over the FACE of the SUN; which grand *Phænomena*, with Respect to the Uses that might have been made of them, I have already treated of at large in my INSTITUTES of ASTRONOMY, to which I refer the Reader. But the NOBLE WORK (for any thing that at present appears) must be left for the Honour of Posterity, viz. finding the PARRALAX of the PLANET and of the SUN, and thereby determining his DISTANCE from Us, and settling the DIMENSIONS of the *Planetary* SYSTEM.